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B.3 DEVELOPMENT AND ANALYSIS OF MANGO LEAF AND JAMUN SEED SYRUP

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ABSTRACT
This project focuses on the formulation and evaluation of a herbal syrup combining mango leaf powder (Mangifera indica) and jamun seed powder (Syzygium cumini) for diabetes management. Diabetes mellitus is a chronic metabolic disorder characterized by elevated blood glucose levels, which can lead to severe complications if left unmanaged. Traditional herbal remedies have gained attention due to their efficacy and minimal side effects. Mango leaves and jamun seeds are rich in bioactive compounds like mangiferin, flavonoids, tannins, and alkaloids, which have proven anti-diabetic, antioxidant, and anti- inflammatory properties. By converting these powders into syrup, the bioavailability and absorption of their active compounds are enhanced, Strach base for Maintaining thickness. The syrup also includes sodium benzoate as a preservative, and a stevia base for improved palatability. This herbal formulation aims to provide a cost-effective, natural, and convenient alternative for managing blood sugar levels while reducing the risk of diabetes-related complications. The study evaluates the stability, safety, and efficacy of the syrup, emphasizing its potential as a complementary approach to diabetes care.

KEYWORD: Mangifera Indica powder, syzygium cumini powder, herbal syrup, anti-diabetic properties, syrup formulation.

1. INTRODUCTION

This project focuses on the formulation and evaluation of an anti-diabetic syrup developed using Jamun seed powder (Syzygium cumini) and Mango leaf powder (Mangifera indica). Both natural ingredients have been extensively documented for their anti-diabetic and antioxidant properties. Jamun seeds are known for their high content of alkaloids, flavonoids, and phenolic compounds that regulate blood sugar levels by enhancing insulin sensitivity, reducing glucose absorption, and improving glycogen synthesis. Similarly, Mango leaves are rich in mangiferin, quercetin, and tannins, which demonstrate hypoglycemic effects, anti-inflammatory activity, and protection against oxidative stress.

The study involves multiple phases

1. Raw Material Processing and Standardization: Extraction and purification of bioactive components from Jamun seeds and Mango leaves using standardized method
2. Formulation Development: Optimization of the syrup composition to ensure stability, bioavailability, and patient acceptability.
3. Pharmacological Studies: In vitro glucose uptake assays and in vivo anti-diabetic studies using diabetic animal models to evaluate the therapeutic efficacy.
4. Physicochemical and Organoleptic Evaluation: Analysis of pH, viscosity, taste, color, and overall acceptability of the syrup.
5. Stability Studies: Assessment of shelf-life under different storage conditions to ensure long-term stability and effectiveness.
6. Minimizing side effect : as they are naturally occurred from nature so they show less side effects.

The research aims to provide a scientifically validated, natural, and affordable herbal remedy for diabetes management. The results are expected to demonstrate the synergistic potential of Jamun seed powder and Mango leaf powder in improving glycemic control while minimizing side effects commonly associated with synthetic drugs. Additionally, the project underscores the importance of integrating traditional herbal knowledge with modern pharmaceutical sciences to address unmet medical needs.

1.2 TYPES AND CAUSES OF DIABETES

Diabetes is a chronic condition that results from issues with insulin production, effectiveness, or utilization in the body. Insulin is a hormone produced by the pancreas that helps regulate blood sugar levels. When the body cannot produce or use insulin effectively, glucose accumulates in the bloodstream instead of being used for

energy. The causes of diabetes vary based on its type but generally involve a combination of genetic, environmental, and lifestyle factors.

1. *Type 1 Diabetes*

Type 1 diabetes is an autoimmune condition in which the immune system mistakenly attacks and destroys the insulin-producing beta cells in the pancreas. As a result, the body produces little or no insulin. The exact cause of this autoimmune response is not fully understood, but it is believed to be a combination of genetic predisposition and environmental triggers, such as viral infections. Unlike other forms of diabetes, Type 1 is not related to lifestyle factors. It is commonly diagnosed in children, adolescents, or young adults and requires lifelong insulin therapy for management.

2. *Type 2 Diabetes*

Type 2 diabetes is primarily caused by insulin resistance, where the body's cells do not respond effectively to insulin, or by a gradual decline in insulin production by the pancreas. This form of diabetes is closely linked to lifestyle factors, including obesity, poor diet, physical inactivity, and stress. Excess fat, particularly around the abdomen, contributes to insulin resistance. Genetics also play a significant role, as individuals with a family history of Type 2 diabetes are more likely to develop the condition. Although it is more common in adults, Type 2 diabetes is increasingly being diagnosed in children and adolescents due to rising obesity rates.

3. *Gestational Diabetes*

Gestational diabetes occurs during pregnancy and is caused by hormonal changes that increase insulin resistance. Hormones such as human placental lactogen, produced by the placenta to support fetal growth, can interfere with the body's ability to use insulin effectively. This condition typically develops in the second or third trimester and usually resolves after childbirth. However, women with gestational diabetes are at a higher risk of developing Type 2 diabetes later in life. Risk factors include obesity, a family history of diabetes, advanced maternal age, and having previously delivered a baby weighing more than 4 kg.

4. *Monogenic Diabetes*

Monogenic diabetes is a rare form of diabetes caused by mutations in a single gene that impair insulin production or function. It is distinct from Type 1 and Type 2 diabetes and is often inherited in an autosomal dominant or recessive pattern. The two main types of monogenic diabetes are Maturity-Onset Diabetes of the Young (MODY generally age group between (25-30), which develops in adolescence or early adulthood, and Neonatal Diabetes Mellitus (NDM), which appears in infants. Genetic testingis crucial for diagnosing monogenic diabetes, as it can often be managed with tailored treatments, such as oral medications instead of insulin.

5. *Secondary Diabetes*

Secondary diabetes arises as a result of other medical conditions or treatments that affect insulin production or action. For instance, diseases such as pancreatitis, cystic fibrosis, or Cushing's syndrome can damage the pancreas or disrupt hormonal balance, leading to diabetes. Certain medications, such as corticosteroids, antipsychotics, or immunosuppressive drugs, can also induce diabetes by causing insulin resistance or impairing insulin secretion.

Other Contributing Factors

In addition to the primary causes, several other factors can increase the risk of developing diabetes. These include genetic predisposition, advancing age, unhealthy dietary habits, chronic stress, and sedentary lifestyles. Environmental factors, such as exposure to toxins or pollutants, may also play a role in disrupting metabolic processes.

1.3 Mango Leaves and Jamun Seeds for Diabetes Management

Mango leaves and jamun seeds are traditional remedies that have been widely recognized in Ayurvedic and herbal medicine for managing diabetes. These natural ingredients are rich in bioactive compounds that help regulate blood sugar levels, making them effective in complementary diabetes care.

Mango leaves (Mangifera indica) are known for their high content of antioxidants, flavonoids, and phenolic compounds, which help improve insulin sensitivity and reduce oxidative stress. The leaves contain a compound called mangiferin, which has been shown to have anti-diabetic properties by aiding glucose uptake in cells and stabilizing blood sugar levels. Consuming mango leaf tea, prepared by boiling fresh or dried leaves in water, can help control fasting blood sugar and support overall metabolic health.

Jamun seeds (Syzygium cumini), on the other hand, are a powerhouse of alkaloids, flavonoids, and tannins, which exhibit hypoglycemic properties. These seeds are particularly effective in slowing down the conversion of starch into sugar, thus preventing sudden spikes in blood sugar levels after meals. Jamun seed powder is often consumed with water or milk to improve insulin activity and enhance glucose utilization. Additionally, jamun seeds help improve pancreatic function, which is vital for insulin secretion.

Both mango leaves and jamun seeds work synergistically to promote better glycemic control and reduce the risk of complications associated with diabetes, such as neuropathy and kidney damage However, while these natural remedies are beneficial, they should be used as part of a comprehensive diabetes management plan, including a healthy diet, regular exercise, and prescribed medications. Consultation with a healthcare provider is recommended before incorporating these remedies into daily routines.

How it Works ?

When mango leaf powder and jamun seed powder are converted into syrup, their bioactive compounds work synergistically to provide multiple benefits in managing blood sugar levels. The syrup enhances insulin sensitivity, controls post-meal blood sugar spikes, supports pancreatic function, reduces inflammation and oxidative stress, and helps maintain long-term glycemic control. This natural remedy can serve as an effective addition to a comprehensive diabetes management routine, contributing to better blood sugar regulation and reduced risk of complications.

Enhanced Absorption and Bioavailability

1. Increases metabolic health

The syrup form increases the bioavailability of the active compounds in mango leaf and jamun seed powders. When these powders are dissolved in a liquid, the body can absorb the nutrients more quickly and efficiently than when they are consumed as dry powders. This ensures that the therapeutic effects of the active ingredients are more effectively utilized in regulating blood sugar levels and improving overall metabolic health.

2. Improved Insulin Sensitivity

Mango leaf powder contains compounds such as mangiferin, flavonoids, and phenolic acids, which have been shown to enhance insulin sensitivity. Insulin sensitivity refers to how effectively the body's cells respond to insulin, allowing for better uptake and utilization of glucose. When insulin sensitivity improves, blood sugar levels become more stable, and insulin resistance—which is a hallmark of Type 2 diabetes—can be reduced. By improving insulin sensitivity, mango leaf syrup helps prevent excessive blood glucose levels, promoting better glycemic control over time.

3. *Control of Post-Meal Blood Sugar Spikes*

One of the significant benefits of jamun seed powder is its ability to regulate blood sugar levels after meals. The active compounds in jamun seeds, particularly alkaloids and flavonoids, help slow down the conversion of starches and carbohydrates into glucose by inhibiting key digestive enzymes such as alpha-amylase and alpha-glucosidase. These enzymes are responsible for breaking down complex carbohydrates into simple sugars, which can cause a rapid increase in blood sugar levels. By blocking these enzymes, the syrup slows down the absorption of sugar into the bloodstream, preventing sudden spikes in blood glucose, especially after meals.

4. *Supporting Pancreatic Function*

Both mango leaf and jamun seed powders play a vital role in supporting the pancreas, which is responsible for insulin production. The compounds in mango leaves help enhance the function of the pancreatic beta cells, which are responsible for producing insulin. Similarly, jamun seed powder helps improve insulin secretion by promoting better pancreatic function, particularly in individuals with Type 2 diabetes, where insulin resistance is prevalent. By improving insulin secretion and ensuring better utilization of insulin, both powders work to stabilize blood sugar levels.

5. *Anti-Inflammatory and Antioxidant Effects*

Chronic inflammation and oxidative stress are common problems faced by individuals with diabetes and contribute to insulin resistance, cardiovascular issues, and organ damage. Both mango leaves and jamun seeds are rich in antioxidants, such as vitamin C, flavonoids, and phenolic compounds, that help neutralize free radicals in the body. Free radicals can cause cellular damage and increase inflammation, leading to complications such as diabetic neuropathy, kidney disease, and cardiovascular issues. The antioxidants in the syrup help reduce oxidative stress, lower inflammation, and protect against long-term complications associated with diabetes.

6. *Long-Term Blood Sugar Regulation*

Consistent consumption of mango leaf and jamun seed syrup can help manage blood sugar levels over time. HbA1c, a marker used to measure long-term blood glucose control, can be lowered with regular intake of this syrup. Both the compounds in mango leaves and jamun seeds help regulate fasting blood sugar levels, improve postprandial glucose control, and prevent long-term fluctuations in blood sugar. By promoting stable blood glucose levels, the syrup helps reduce the risk of diabetes- related complications, such as vision problems, nerve damage, and kidney disease.

7. *Convenient and Potent Form*

Converting mango leaf powder and jamun seed powder into syrup offers a more convenient method of consumption. While powders may require mixing or preparation, syrups are easy to take and can be incorporated into daily routines effortlessly. The liquid form ensures that the bioactive compounds are absorbed quickly by the body, providing an immediate effect. For those who find it difficult to consume the powders regularly, the syrup serves as a more practical solution, offering the same benefits in a more user-friendly form.

8. *Complementary to Conventional Treatment*

While mango leaf and jamun seed syrup can be highly beneficial in managing diabetes, it should be used as a complementary treatment alongside conventional diabetes management methods. A balanced diet, regular exercise, and prescribed medications remain essential for optimal diabetes care. The syrup can help enhance the effectiveness of these treatments, improving overall blood sugar control. However, it is crucial to consult with a healthcare provider before adding the syrup to your diabetes management plan, particularly if you are on insulin or oral medications, to avoid any potential interactions.

METHODS AND MATERIALS

A. COMPOSITION

Table no. 1: Formulation Table for herbal syrup.

Sr.no	Ingredients	Quantity
1.	Mango leaf powder	20gm
2.	Jamun powder	20gm
3.	Starch	0.2gm
4.	Sodium benzonate	0.5gm
5.	Stevia	0.5gm
6.	Water	Qs

B. *INGREDIENTS PROFILE*

B.1 Mango leaf powder:- Botanicals Name: Mangifera indica

Source: Leaves of the mango tree

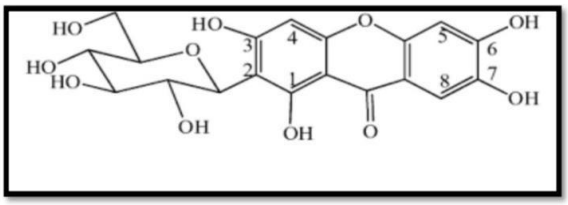
Key Compounds: Mangiferin, flavonoids, phenolic acids, tannins

Function

Acts as an anti-diabetic agent by improving insulin sensitivity and reducing blood glucose

- Levels.
- Contains antioxidants that reduce oxidative stress and inflammation, protecting against.
- diabetes-related complications.
- Supports pancreatic beta-cell function and helps regulate fasting and postprandial blood.
- sugar levels.
- Role in Syrup: Active ingredient for managing diabetes and improving metabolic health.

Role in Syrup: Active ingredient for managing diabetes and improving metabolic health.



MANGIFERA INDICA

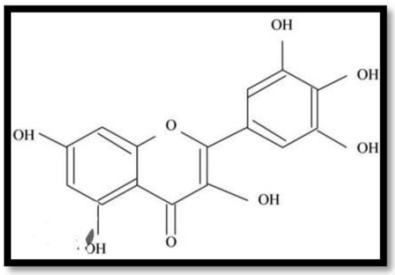
B.2 Jamun Seed Powder Botanical Name: Syzygium cumini.

Source: Seeds of the jamun fruit.

Key Compounds: Alkaloids, flavonoids, tannins, glycosides.

Function

- Regulates post-meal blood sugar spikes by inhibiting enzymes responsible for carbohydrate
- digestion (alpha-amylase and alpha-glucosidase).
- Promotes insulin secretion and pancreatic function.
- Reduces oxidative stress and inflammation.
- Role in Syrup: Active ingredient for controlling blood sugar levels and supporting long-term
- glycemic management.



SYZGIUM CUMINI

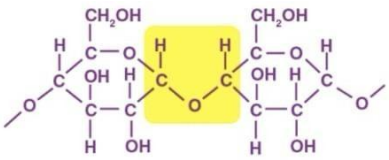
B.3 Starch

Chemical formula:- $(C_6H_{10}O_5)n$

Source: Starch used in pharmaceuticals is derived from natural plant sources, such as: Corn starch (Zea mays).

Functions

- Helps hold the ingredients of a tablet together during compression.
- Aids in breaking the tablet into smaller fragments in the gastrointestinal tract, promoting dissolution and absorption.
- Provides bulk to tablets or capsules when the active pharmaceutical ingredient (API) is in a small quantity.
- Reduces friction between particles, improving the flow of powders during tablet manufacturing.
- Used in the film coating of tablets to improve stability, mask taste, or control release.



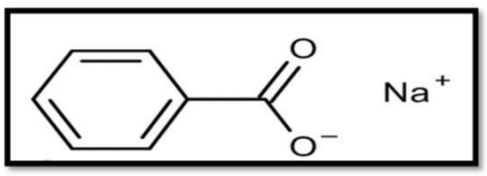
Simple starch

B.4 Sodium Benzoate Chemical Formula: $C_7H_5NaO_2$

Source: Synthetic preservative.

Function

- Prevents the growth of bacteria, yeast, and molds, extending the shelf life of the syrup
- Works effectively in acidic conditions created by citric acid.
- Role in Syrup: Preservative to maintain stability and safety during storage.



SODIUM BENZOATE

Stevia

Botanical Name: Stevia rebaudiana

Chemical Name: Steviol glycosides (mainly stevioside

and rebaudioside A)
Source: Leaves of the Stevia plant

Role in syrup: Stevia is a natural sweetener derived from the leaves of the Stevia rebaudiana plant, native to South America. The primary chemical constituents responsible for its sweetness are steviol glycosides, particularly stevioside and rebaudioside A, which are up to 300 times sweeter than sucrose (table sugar).

B.5 Water
Chemical Formula: H_2O
Source: Purified or distilled water

Function
- Acts as a solvent to dissolve and homogenize all ingredients.
- Provides the liquid medium for syrup formulation.
- Role in Syrup: Base solvent for combining all components and ensuring a consistent, drinkable
- product.

C. AIM NEED AND OBJECTIVE

To formulate a natural, effective, and easy-to-use syrup combining mango leaf powder and jamun seed powder to help manage blood sugar levels in individuals with diabetes.

This formulation meets the need for an easily consumable, natural remedy that complements existing diabetes management strategies, addressing the growing demand for holistic healthcare solutions.

To formulate a syrup using mango leaf powder and jamun seed powder.

To investigate the effectiveness of the syrup in regulating blood sugar levels: To enhance the bioavailability of bioactive compounds. To ensure product safety and stability. To evaluate the convenience and acceptability of the syrup. To contribute to natural, herbal solutions in diabetes management.

D. METHODOLOGY

- ***Collection and Preparation of Ingredients***

Mango leaves and jamun seeds, both known for their anti-diabetic properties, were selected as the core ingredients. The mango leaves were carefully cleaned, shade-dried, and powdered to preserve their bioactive compounds. Similarly, jamun seeds were dried and ground into a fine powder, ensuring maximum extraction of their therapeutic components.

- ***Extraction of Active Compounds***

The powdered mango leaves and jamun seeds were subjected to hydroalcoholic extraction using a mixture of ethanol and water (70:30). This process involved soaking the powders for 24–48 hours, followed by filtration to remove solid particles. The filtrate was then concentrated at a low temperature to obtain a thick, active extract rich in bioactive compounds.

- ***Preparation of Syrup Base***

To create a diabetic-friendly syrup, starch was used as a base instead of sugar. A slurry of starch was prepared by dissolving it in cold water and then heating it in boiling water while stirring to achieve a clear and consistent solution. A small quantity of preservative (e.g., sodium benzoate) was added to ensure the syrup's stability and longevity.

- ***Formulation of Herbal Syrup***

The mango leaf and jamun seed extracts were carefully blended with the starch-based solution. This mixture was stirred thoroughly to ensure even distribution of the extracts. The final syrup was adjusted to a volume of 500 mL with purified water, ensuring a smooth and uniform consistency.

- ***Packaging and Storage***

The prepared syrup was filtered to remove any impurities or undissolved particles. It was then transferred into sterilized bottles, sealed, and stored in a cool, dry place for further evaluation and testing.

E. EVALUATION PARAMETERS

- ***Physical Appearance***

The syrup was assessed for clarity, consistency, and color. A good herbal syrup should have a uniform appearance, free from particles or cloudiness.

- ***Aroma and Taste***

The sensory profile, including the herbal aroma and taste, was evaluated to ensure it was pleasant and acceptable for daily consumption.

- ***pH Measurement***

The pH was tested to confirm the syrup's stability, ideally ranging between 4.5 and 6.5, ensuring safety and preventing microbial growth.

- ***Total Solids Content***

This parameter measured the concentration of active ingredients in the syrup, ensuring it contained adequate therapeutic compounds.

- ***Bioactive Compound Testing***

Key compounds like mangiferin, flavonoids, and alkaloids were analyzed to confirm their presence and ensure the syrup's efficacy in managing blood sugar.

- ***Stability Testing***

The syrup was tested over time to ensure it remained stable without physical separation or degradation of active ingredients.

- ***Texture and Consistency***

The texture was evaluated to ensure the syrup was smooth and easy to pour or consume, avoiding any grittiness or clumping.

- ***Sweetness and Acceptability***

Since starch was used as a base, the syrup's taste was tested to ensure it was palatable without relying on sugar.

- ***Therapeutic Efficacy***

Preliminary testing focused on the syrup's ability to regulate blood sugar levels and improve metabolic health, confirming its anti-diabetic potential.

- ***Safety and Shelf-Life***

The syrup was tested for microbial contamination and preservation over time to ensure it was safe for consumption and had an adequate shelf life.

F. CONCLUSION

This study focused on developing a natural and effective herbal syrup using mango leaf powder and jamun seed powder to help manage diabetes. By replacing sugar with starch, the syrup ensures it is suitable for diabetic patients while maintaining stability and ease of use. The extraction process successfully captured key bioactive compounds, such as mangiferin, flavonoids, and alkaloids, which work synergistically to regulate blood sugar levels.

The syrup showed promise in enhancing insulin sensitivity, controlling post-meal blood sugar spikes, and supporting pancreatic function. It also offered anti-inflammatory and antioxidant benefits, reducing the risk of complications commonly associated with diabetes. Stability and sensory evaluations confirmed the syrup's quality, safety, and acceptability.

This formulation provides a convenient, natural alternative for individuals seeking to complement conventional diabetes treatments. With further testing and validation, this syrup could play a significant role in holistic diabetes care, offering hope for better long-term blood sugar management.

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